Predicting acute maxillary sinusitis in a general practice population

Jens Georg Hansen, Henrik Schmidt, Jørn Rosborg, Elisabeth Lund

Abstract

***Objective*—To evaluate the diagnostic value of symptoms, signs, erythrocyte sedimentation rate, and C reactive protein for acute maxillary sinusitis.**

***Design*—Prospective cohort study.**

***Setting*—Danish general practice in cooperation with the otorhinolaryngology and neuroradiology department at Aalborg County Hospital.**

***Subjects*—174 patients aged 18-65 years who were suspected by the general practitioner of having acute maxillary sinusitis.**

***Main outcome measure*—The independent association of symptoms, signs, erythrocyte sedimentation rate, and concentration of C reactive protein in patients with acute maxillary sinusitis defined as purulent or mucopurulent antral aspirate.**

***Results*—Only raised erythrocyte sedimentation rate (P=0·01) and raised C reactive protein (P=0·007) were found to be independently associated with a diagnosis of acute maxillary sinusitis. The combination of the two variables had a sensitivity of 0·82 and a specificity of 0·57.**

***Conclusion*—Erythrocyte sedimentation rate and C reactive protein are useful diagnostic criteria for acute maxillary sinusitis.**

Introduction

Acute maxillary sinusitis, an inflammation in the sinus maxillaris lasting no longer than one month, is often diagnosed in general practice,[1-3] but documentation for the usefulness of specific diagnostic criteria is scarce.[4-9] Acute maxillary sinusitis is pathophysiologically defined as a condition with closed ostium and presence of pus in the sinus. The description of the symptoms and signs related to this condition is often imprecise, and a diagnosis is made mainly from criteria derived from patients seen in other studies.[4-9] Purulent secretion can be documented only by sinus aspiration.[7] Adjunctive tests such as plain radiography, A-mode ultrasonography, computed tomography, and magnetic resonance imaging may be of value in diagnosis,[3 10-15] but these investigations are not available in general practice surgeries or primary care clinics.

Sixteen per cent of all antibiotics prescribed for adults in Danish general practice are for acute maxillary sinusitis.[16] Acute maxillary sinusitis is thus either extremely common or it is overdiagnosed, resulting in an increased consumption of antibiotics.

This present study evaluates the diagnostic value of different symptoms, signs, and laboratory tests used to diagnose acute maxillary sinusitis (defined as purulent or mucopurulent antral aspirate) in patients suspected of having the condition.

Method

The study took place from 27 April 1992 to 28 February 1994 in Aalborg, an industrial town with about 125 000 inhabitants. Eight general practices participated for some or all of the investigation period. Patients suspected of having acute maxillary sinusitis and aged 18-65 years were consecutively included once during the study period. Patients were excluded for the following reasons: pregnancy; previous surgery in the sinus maxillaris; malignant disease in the ear, nose, or throat; current treatment with antibiotics; rheumatic arthritis or other collagen diseases; treatment with steroids; immunotherapy; and unwillingness to participate.

Age and sex were noted and the following symptoms were recorded: duration of illness, knowledge of previous sinusitis, preceding upper respiratory tract infection, cough, nasal congestion, pain in the maxillofacial area, pain in the upper teeth, pain in the maxillary sinuses on bending forward, anosmia, and cacosmia. The following signs were recorded: tenderness of maxillary sinuses, pain on tapping the teeth of the upper jaw, oedema of the skin over the maxillary sinuses, purulent discharge below the middle conchae, swollen inflamed turbinates visualised by anterior rhinoscopy, and pus on the posterior wall of the pharynx. Body temperature was measured and two blood samples were taken to estimate the erythrocyte sedimentation rate and concentration of C reactive protein (NycoCard CRP whole blood, Nycomed Pharma). Both analyses were performed in the clinic.

Patients were admitted within 24 hours to the neuroradiological department of the county hospital in Aalborg for computed tomography. The examination was performed on the supine patient with 10 mm transverse slices, parallel to the palate, and through the entire maxillary sinuses (4-6 slices, 133 kV, 350 mAs, W:1500 and C:175). Dose to the lens of the eye was measured in a phantom to 1·5-1·6 mSv per computed tomography examination. The same dose in conventional radiography of the sinuses was measured to 5·1-8·6 mSv.

The computed tomography examination was evaluated by a senior radiologist with regard to absence or presence of mucosal swelling and fluid in the right and left maxillary sinuses. Patients without mucosal swelling and fluid were classified as not having acute maxillary sinusitis. When there was mucosal thickening or fluid in one or both maxillary sinuses the patient was immediately referred to the otological department, where a sinus aspiration was performed after topical anaesthesia (lidocain 10%, noradrenalin 1%) had been applied to the posterior part of the middle meatus on a piece of cotton, and to the inferior meatus by means of a cotton swab and an infiltrative anaesthesia (lidocain 2%, noradrenalin 0·5%) injected below and to the side of the inferior concha. A needle puncture was performed through the inferior meatus with a 1·4 mm lumbar puncture needle. Antral aspiration was attempted, and in each case antral lavage was performed with 60-100 ml 0·9% saline solution. If the aspirate or the antral lavage contained either purulent or mucopurulent material, the patient was diagnosed as having acute maxillary sinusitis. Before the antral

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lavage the nasal cavities were cleared of mucus or pus by means of aspiration. Any purulent or mucopurulent material obtained was sent to the department of microbiology for bacterial culture.

Participation in the investigation was voluntary. Oral and written information was given and a consent form was signed by the patient. The patients were told that they would have a sinus puncture only if the computed tomography examination showed infection in the sinuses, that the puncture would be performed by a trained specialist and after application of sufficient local anasthesia, and that sinus puncture in itself is an effective treatment. The investigation was accepted by the regional scientific ethics committee.

STATISTICAL METHODS

Univariate analysis was calculated by using odds ratios and the χ^2 test; multivariate analyses were calculated by using logistic regression. Significance level was set to 5%, and 95% confidence intervals were estimated with Miettinen's method.[17]

Results

In all, 282 patients were eligible for the study. Seventy seven were excluded because of: pregnancy (9); previous surgery to the maxillary sinus (5); antibiotic treatment for concurrent diseases (9); oral steroid treatment for a chronic disease (1); and declined participation (53). An additional 31 patients changed their minds about participation and were taken out. The 77 patients who did not participate did not differ in sex or median age from the patients who completed the study, but no symptoms, signs, or laboratory tests were obtained for these patients. The 31 patients who withdrew showed no significant differences from the patients who completed the study in regard to sex, median age, symptoms, signs, and laboratory tests (χ^2 test). The 174 patients who completed the study had a median age of 35 years (2·5 and 97·5 centiles 19 and 62). Of these, 117 (70%; 95% confidence interval 63% to 77%) were women. A total of 122 (70%; 63% to 77%) of the patients had abnormalities on computed tomography examination and 92 (53%; 43% to 62%) met the diagnostic criteria of acute maxillary sinusitis.

TABLE I—*Association of symptoms and signs with diagnosis of acute maxillary sinusitis*

	Acute maxillary sinusitis		
	No (%) present (n=92)	No (%) absent (n=82)	Odds ratio (95% confidence interval)
Symptoms:			
Illness >1 day	88 (96)	76 (93)	1·7 (0·5 to 6·3)
Previous sinusitis	57 (62)	66 (81)	0·4 (0·2 to 0·8)
Preceding upper respiratory tract infection	82 (89)	65 (79)	2·1 (0·9 to 4·9)
Cough	62 (67)	51 (62)	1·3 (0·7 to 2·3)
Nasal congestion	73 (79)	64 (78)	1·1 (0·5 to 2·2)
Maxillary pain:			
None	5 (5)	2 (2)	3·1 (0·6 to 15·6)
Unilateral	47 (51)	31 (38)	1·9 (1·0 to 3·4)
Bilateral	40 (44)	49 (60)	
Maxillary toothache	61 (66)	42 (51)	1·9 (1·0 to 3·5)
Pain bending forward	69 (75)	63 (77)	0·9 (0·4 to 1·8)
Anosmia	57 (62)	47 (57)	1·2 (0·7 to 2·2)
Cacosmia	36 (39)	29 (35)	1·2 (0·6 to 2·2)
Signs:			
Temperature >38°C	11 (13)	9 (11)	1·1 (0·4 to 2·8)
Purulent nasal discharge	29 (32)	18 (22)	1·6 (0·8 to 3·2)
Purulent pharyngeal discharge	20 (22)	15 (18)	1·2 (0·6 to 2·6)
Swollen inflamed turbinates	63 (68)	56 (68)	1·0 (0·5 to 1·9)
Tenderness of maxillary sinus:			
Unilateral	45 (49)	26 (32)	2·5 (1·2 to 5·2)
Bilateral	27 (29)	28 (34)	1·4 (0·6 to 3·0)
None	19 (21)	27 (33)	
Tenderness on tapping the maxillary teeth	39 (42)	30 (36)	1·2 (0·7 to 2·3)
Oedema over maxillary sinus	25 (27)	31 (38)	0·6 (0·3 to 1·2)

TABLE II—*Association of erythrocyte sedimentation rate with diagnosis of acute maxillary sinusitis*

	Acute maxillary sinusitis		
Erythrocyte sedimentation rate (mm/h)	No (%) present	No (%) absent	Odds ratio (95% confidence interval)
Men:	(n=32)	(n=19)	
>30	8 (25)	1 (5)	12·4 (1·8 to 85·0)
11-30	13 (41)	1 (5)	20·1 (3·3 to 122·0)
<11	11 (34)	17 (90)	
Women:	(n=57)	(n=60)	
>30	15 (26)	4 (7)	6·2 (2·0 to 19·0)
21-30	14 (25)	10 (17)	2·3 (0·9 to 5·8)
<21	28 (49)	46 (76)	

TABLE III—*Association of concentration of C reactive protein with diagnosis of acute maxillary sinusitis*

	Acute maxillary sinusitis		
	No (%) present (n=92)	No (%) absent (n=81)	Odds ratio (95% confidence interval)
C reactive protein (mg/l)			
>49	30 (33)	8 (10)	7·4 (3·1 to 18·0)
49-25	18 (19)	10 (12)	3·5 (1·4 to 8·6)
24-11	19 (21)	14 (17)	2·7 (1·2 to 6·1)
<11	25 (27)	49 (60)	

TABLE IV—*Association of clinical criterion (either erythrocyte sedimentation rate >10 mm/h in men or >20 mm/h in women, or C reactive protein >10 mg/l in both sexes) with diagnosis of acute maxillary sinusitis*

	Acute maxillary sinusitis		
	No (%) present (n=89)	No (%) absent (n=79)	Odds ratio (95% confidence interval)
Clinical criterion:			
Present	73 (82)	34 (43)	6 (3·1 to 11·8)
Absent	16 (18)	45 (57)	

Acute maxillary sinusitis was more frequently diagnosed in the age group 31-45 years (odds ratio 2·3; 4·2 to 1·22) than in patients aged 18-30 and 46-65; no differences were found between sexes. Table I shows the symptoms and signs associated with acute maxillary sinusitis. Maxillary pain was the most common symptom. Only unilateral pain and maxillary toothache were significantly associated. The patient's statement of previous sinusitis was negatively associated. The only sign that showed significant association was unilateral tenderness of the maxillary sinus. Tables II and III show the univariate associations of erythrocyte sedimentation rate and C reactive protein with acute maxillary sinusitis. On the basis of the results of the univariate analyses and knowledge of the subject, the following symptoms and signs were used in a multivariate analysis: age, preceding upper respiratory tract infection, maxillary pain, tenderness of maxillary sinus, maxillary toothache, purulent nasal discharge, purulent pharyngeal discharge, erythrocyte sedimentation rate, and concentration of C reactive protein. In this additive logistic regression only erythrocyte sedimentation rate and C reactive protein were independently associated with the diagnosis of acute maxillary sinusitis (P=0·01 and P=0·007, respectively); age (P=0·07), preceding upper respiratory tract infection (P=0·68), maxillary pain (P=0·26), tenderness of maxillary sinus (P=0·75), maxillary toothache (P=0·17), purulent nasal discharge (P=0·49), and purulent pharyngeal discharge (P=0·50) were not.

The cut off point for erythrocyte sedimentation rate (above which most patients are likely to have acute maxillary sinusitis) was 10 mm/h for men and 20 mm/h for women. The cut off concentration for C reactive protein was found to be 10 mg/l for both sexes. The

combination of these two variables (raised C reactive protein and erythrocyte sedimentation rate) in a clinical criterion had a sensitivity of 0·82, a specificity of 0·57, a positive predictive value of 0·68, and a negative predictive value of 0·74 (table IV),

Pathogenic bacteria were found in the culture of sinus aspirate of six patients (66%; 56% to 76%); a negative result was found in 20 (22%; 14% to 32%) and there were 11 (12%) missing cases. *Haemophilus influenzae* was found in 23 cultures (38%; 29% to 48%), *Streptococcus pneumoniae* in 22 (36%; 28% to 46%) β haemolytic streptococci group A in 5 (8%; 4% to 15%), *Staphylococcus aureus* in 3 (5%; 2% to 12%), *Moraxella catarrhalis* in 1 (2%; 0·2% to 6%) and miscellaneous bacteria in 7 (12%; 7% to 19%). Using positive results of culture as the diagnostic criterion did not give different results from those obtained using our diagnostic criterion.

Key messages

- Only the erythrocyte sedimentation rate and the C reactive protein concentrations were independently associated with the diagnosis of acute maxillary sinusitis
- None of the general accepted symptoms and signs were independently associated with the diagnosis of acute maxillary sinusitis
- Only 53% of the patients suspected of having acute maxillary sinusitis in general practice had purulence or mucopurulence in the sinus aspirate
- This study confirms the hypothesis that the acute maxillary sinusitis is ovediagnosed in general practice

Discussion

This study found that erythrocyte sedimentation rate and concentration of C reactive protein were independently associated with the diagnosis of acute maxillary sinusitis, but none of the traditionally accepted symptoms and signs were independently associated.[18 19] This means that clincial examination is more or less worthless. Two explanations may apply: firstly, symptoms and signs are often defined according to pathophysiological conditions, but this method is not applicable here as many patients without acute maxillary sinusitis had the same symptoms and signs as patients complying with our diagnostic criterion for the condition. As well, many studies enrol selected patients from ear, nose, and throat clinics, often in small numbers, and most of these patients have more pronounced symptoms and signs than do patients in primary care.

Our choice of specific symptoms and signs in the multivariate analysis was based on the result of the univariate analyses and the fact that these variables are regarded as possible markers of sinus empyema.[2 3 5] In our study the patients were included if the general practitioner suspected acute maxillary sinusitis because a clinical standard criterion for acute maxillary sinusitis is lacking.[6] By this method we achieved a broad spectrum of patients' symptoms and signs, reflecting the clinical situation in primary care. In this way we avoided verification bias to a certain degree as our inclusion criterion was not applied only to patients with a high probability of disease. However, pain seemed to be the symptom that general practitioners paid the most attention to as this symptom was found in nearly all patients.

Almost a third of the patients either refused to participate in the study or withdrew. The main reason for this lack of compliance was probably fear of antral puncture. As we have no data on symptoms or signs in patients who did not enter the study, we do not know to what degree their lack of participation influenced the final results. We may assume, however, that their disease was less severe than that of the patients who completed the study, and so their non-participation influenced the result to a minor degree. The patients who chose to withdraw during the study did so for different reasons—they did not show up at the hospital for a computed tomography examination or refused to have an antral puncture if the examination showed any abnormalities. These patients did not differ significantly from patients who completed the study.

We chose the result of antral puncture as the criterion for acute maxillary sinusitis because it has been shown to be of higher value than non-invasive methods,[7] and we found mucosal swelling or increased fluid in 70% of the patients on computed tomography, but only 53% had purulence or mucopurulence on puncture. This difference could be due to the patients' having sinusitis with effusion and not purulence, which would agree with several other studies.[7 8] Even though computed tomography is considered to be more sensitive than conventional radiography, our study showed that it is not precise enough to diagnose acute maxillary sinusitis.

Patients' statements that they had had sinusitis was negatively associated with current acute maxillary sinusitis. This contradicts the findings of another study[2] and may result from overdiagnosis of the disease in primary care.

Both erythrocyte sedimentation rate and C reactive protein concentration are better diagnostic criteria for acute maxillary sinusitis than the other symptoms and signs, and both analyses can easily be performed in general practice clinics. The concentration of C reactive protein usually increases within 24 hours after onset of the infection and falls quickly after treatment or spontaneous improvement. Recently C reactive protein has been suggested as a useful test for differentiating between bacterial and viral infections; for this reason the C reactive protein test has become increasingly relevant for primary care.[20]

A clinical criterion based on raised values of erythrocyte sedimentation rate or C reactive protein (even though it is not optimal, with positive and negative predictive values of 0·68 and 0·74) seems to be a better basis for deciding to give antibiotics to the patient than is clinical examination.

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Videotaping of general practice consultations: effect on patient satisfaction

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Videotaping of general practice consultations has assumed a high profile recently with its proposed use in summative assessment of general practice trainees, fellowship by assessment, and the membership examination of the Royal College of General Practitioners. The presence of a video camera does not alter doctors' behaviour,[1,2] and most patients are happy to give consent to videotaping.[3] Videotaping might, however, adversely affect the consultation from the patient's point of view: one study found that most patients would feel uncomfortable during consultations that were being videotaped.[4]

We compared patient satisfaction scores after videotaped consultations and after consultations that were not videotaped, on the basis that if patiens felt uncomfortable their scores would be lower.

Methods and results

Eighteen general practitioner trainers participated in the study. Each used two consulting sessions for the study. One was videotaped after obtaining appropriate consent, the other was not. After each consultation patients were asked to complete a validated and reliable satisfaction questionnaire.[5] They were assured of anonymity, and they completed the questionnaires in the waiting room after the consultation. From work in a similar patient population we calculated that 100 patients per group would have a power of 90% to detect differences in satisfaction as small as 5% between the groups. The results were analysed with SPSS-X . They were normally distributed, and variances were homogeneous with Bartlett's test. Data were compared by Student's *t* test.

A total of 379 questionnaires were returned, 182 from the videotaped group and 197 from the group that was not videotaped. The groups were well matched for age and sex. Eighteen (9%) patients withheld consent to videotaping. The findings are shown in the table. We found no significant differences in overall satisfaction or in any of the subscales. Analysis by individual practices showed no significant differences in patient satisfaction between those whose consultations had been videotaped and those whose consultations had not, for any doctor.

Patient satisfaction scores after videotaping of consultations. Values are means (SD)

Scale	Videotaped group (n=182)	Group that was not videotaped (n=197)	Two tailed probability of difference between means
Total satisfaction	72·1 (9·1)	72·2 (8·6)	0·80
General satisfaction	12·6 (2·1)	12·3 (2·0)	0·29
Professional care	29·2 (4·2)	29·5 (3·4)	0·73
Relationship	18·9 (3·7)	18·9 (3·6)	0·86
Perceived time	11·4 (2·6)	11·3 (2·5)	0·58

Comment

The use of videotaped consultations in summative assessment would be valid only if the process did not affect the consultation. Bain and Mackay suggested that most patients would feel uncomfortable during a videotaped consultation and that the use of a video camera is unacceptably intrusive.[4] A major drawback of their study, however, was that none of the patients had ever been asked to take part in a videotaped consultation.

Our study shows that there is no difference in patient satisfaction between a group that was videotaped after having given consent and another that was not videoed. The allocation of patients to each group was random except that only the patients who agreed to be videotaped could be allocated to the videotaped group. Such patients may be different from those who were not asked since the group that was not asked will contain some patients who would refuse to be videotaped. However, over 90% of the patients asked agreed to the videotaping, and in any event the ethical objections concern patients who do not refuse to take part but feel uncomfortable being videotaped. We believe that if patients were unhappy their feelings would be reflected in the satisfaction scores. Therefore, provided that appropriate informed consent is obtained, videotaping of consultations seems to have no detrimental effects on patient satisfaction.

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